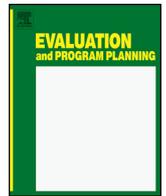




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Process evaluation of a preschool physical activity intervention using web-based delivery[☆]



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ABSTRACT

Background and purpose: Preschool/childcare settings offer a practical target for physical activity interventions. Online learning programs have the potential for greater public health reach and impact. The SHAPES-Dissemination (SHAPES-D) project adapted the original SHAPES in-person intervention for online delivery to teachers. The purpose of this paper is to describe the implementation monitoring and process evaluation for the SHAPES-D project.

Methods: Nine preschools with 26 classrooms participated. A total of 41 teachers were trained via online learning to implement the SHAPES-D program in their classrooms. The dose received, completeness, and fidelity of implementation were assessed through website metrics, teacher surveys and interviews, and classroom observations.

Results: Dose received was adequate (73%). Observed completeness and physical activity enjoyment fidelity were high (100%), although moderate-to-vigorous physical activity fidelity and social environment fidelity were low (25% each). Overall implementation was high (91%).

Discussion: Results indicate that the online method of delivery is viable for dissemination. The online delivery system provides an easy method of monitoring dose received. This may be the first structural intervention to monitor dose received through web metrics.

Conclusion: The adaptation of an in-person intervention to an online delivery system increases the potential for dissemination of a successful program to increase physical activity in preschool settings.

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1. Introduction

1.1. Preschool children and physical activity

Physical activity in early childhood is associated with multiple health benefits (Hinkley et al., 2014; Timmons et al., 2012). Specifically in this population, moderate-to-vigorous physical activity (MVPA) has been shown to improve bone health later in life (Janz et al., 2010), and PA during early childhood is associated with weight status and may have a protective effect on adiposity (Janz et al., 2009; Moore et al., 2003; Reilly, 2008). Additionally, higher

levels of MVPA in early childhood may protect against chronic disease throughout the life-course (Tremblay et al., 2015). Despite compelling evidence for the benefits of PA, current levels of PA among preschool students fall far below the recommended standards (Cardon & De Bourdeaudhuij, 2008; Hinkley, Salmon, Okely, Crawford, & Hesketh, 2012; Pate, McIver, Dowda, Brown, & Addy, 2008; Reilly, 2010). Therefore, increasing PA in preschool children should be a public health priority (Lessard & Breck, 2015; Sallis et al., 2012; Wright et al., 2015).

1.2. Preschools as settings for increasing physical activity

Preschool and childcare settings pose a practical target for intervention. In the United States, 61% of 3- to 6-year-old children not yet in kindergarten are enrolled in preschool or childcare outside the home (Federal Interagency Forum on Child & Family Statistics, 2015). The characteristics of a preschool, including policies and practices regarding PA, can significantly influence

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children's activity levels (Dowda et al., 2009; Pate et al., 2008; Pate, Pfeiffer, Trost, Ziegler, & Dowda, 2004).

Results from studies in preschool settings show inconsistent effects for increasing moderate-to-vigorous physical activity (MVPA) (Annesi, Smith, & Tennant, 2013; De Bock, Genser, Raat, Fischer, & Renz-Polster, 2013; De Craemer et al., 2014; Fitzgibbon et al., 2011; Hannon & Brown, 2008), and few studies reported process evaluation in an effort to explain intervention effects. Poor implementation may contribute to inconsistent findings as level of implementation has been shown to affect results (Durlak & DuPre, 2008; Wilson et al., 2009). Those that have monitored implementation have shown that low implementation could be one reason for the lack of significant results. For example, Trost, Fees, and Dziewaltowski (2008) utilized process evaluation methods in order to explore the frequency and contexts in which their intervention was delivered by preschool teachers. Only seventy-four percent of the movement activities met the intervention time requirements, and classroom observations revealed that preschool teachers were not implementing the intervention as it was intended, thus explaining the null findings during the first half of the study (Trost et al., 2008). Bonvin and colleagues noted that while there was no significant change in outcomes, not all child care centers delivered all the program components (Bonvin et al., 2013). Alhassan and Whitt-Glover noted teachers indicated barriers that limited the implementation of the intervention and no PA changes were noted (Alhassan & Whitt-Glover, 2014).

Intervention delivery may also impact the results. Some studies aiming to increase PA in preschools have employed trained research staff for implementation (Finch, Jones, Yoong, Wiggers, & Wolfenden, 2016; Fitzgibbon et al., 2011; Hannon & Brown, 2008), whereas others have trained teachers (Alhassan & Whitt-Glover, 2014; Annesi, Smith, & Tennant, 2013; De Craemer et al., 2014; Finch et al., 2014; Finch et al., 2016; Trost et al., 2008) and/or involved parents (De Bock et al., 2013; Finch et al., 2016) to deliver the intervention. Research indicates that in-person interventions delivered by research staff may not effectively reach teacher change agents, who deliver the intervention, or children, who are the priority audience. For example, Finch and colleagues (2014) found that only 41% of preschool staff attended the intervention's training workshop, and at one site, only 18% of the teachers were in attendance (Finch et al., 2014). In a community-based preschool PA intervention, De Bock and others (2013) found that, although the intervention implementation and adoption rates were relatively high (80% and 83%, respectively), only 33% of eligible children were reached. Methods must be tested that enable evidence-based programs to reach a wider audience in order to have a greater public health impact (Brownson, Jacobs, Tabak, Hoehner, & Stamatakis, 2013; Neta et al., 2015; Riley, Glasgow, Etheredge, & Abernethy, 2013) and new methods for addressing barriers to implementation should be explored.

1.3. Online program delivery

The use of eTechnology (web applications or mobile apps) in interventions is growing (Barretto, Bingham, Goh, & Shope, 2011; Rosa, Campbell, Miele, Brunner, & Winstanley, 2015; Santoro, Nicolis, Franzosi, & Tognoni, 1999), and it has the potential to promote widespread reach. Research indicates that while gaps still exist within some demographics, 84% of American adults are using the internet (Perrin & Duggan, 2015). Obstacles to translating research to practice have been identified. For example, failure to design interventions for dissemination creates stumbling blocks toward bringing research into practice-based settings (Brownson et al., 2013; Cohen et al., 2008; Glasgow, Lichtenstein, & Marcus, 2003). Interventions that use technology in their delivery design may help to diminish the research-to-practice gap and may

address barriers to implementation of PA programs within preschool settings. Additionally, online learning programs allow for a greater public health reach and impact if programs can be delivered as effectively as in face-to-face interventions (Rosa et al., 2015; Santoro et al., 1999).

1.4. Program description

The SHAPES (Study of Health and Activity in Preschool Environments) intervention was a flexible and adaptive environmental (i.e., structural) intervention delivered by teachers (change agents) to change instructional practices and classroom social environments in an effort to increase preschool children's MVPA (Howie et al., 2014; Pate et al., 2016; Pfeiffer et al., 2013). The results indicated that students in the intervention schools accumulated significantly more MVPA than students in control schools, with a stronger intervention effect for girls than for boys (Pate et al., 2016). The original SHAPES intervention (Howie et al., 2014; Pate et al., 2016; Pfeiffer et al., 2013) consisted of four essential elements: indoor PA opportunities ("Move Inside"), outdoor free play and structured PA opportunities ("Move Outside"), PA integrated with pre-academic lessons ("Move to Learn"), and enhanced social support (i.e., teacher participation, teacher encouragement, child enjoyment).

In an effort to increase the reach of this intervention, the original SHAPES in-person delivery methods were adapted for web-based delivery through the SHAPES-Dissemination (SHAPES-D) project. The intervention team incorporated the key training components from the original SHAPES intervention (i.e., SHAPES philosophy, PA definitions, essential elements, self-assessment, etc.) into six online training modules. The modules included an introduction to SHAPES-D, PA concepts, PA components (Move Inside, Move Outside, and Move to Learn), strategies for enhancing PA quality, self-assessments, and a review of the course. In addition to the online training modules, teachers received a hard copy of SHAPES-D materials, including a guidebook detailing the information presented in each module, sample activities, and laminated activity cards with actions to facilitate activity implementation.

1.5. Purpose

Studies delivered in real world preschool/childcare settings are needed to influence future policy changes (Finch et al., 2016), and process evaluation and implementation monitoring are needed to explain intervention results (Bopp, Saunders, & Lattimore, 2013; Durlak & DuPre, 2008; Saunders, Evans, & Joshi, 2005). Triangulating measures of teacher dose received, implementation completeness, and implementation fidelity provide insight into the level of implementation of an intervention (Bopp et al., 2013; Saunders, 2015; Wilson et al., 2009). Furthermore, investigating teacher perceived barriers provides insights to reduce/prevent barriers to implementation in future studies. The purpose of this paper is to describe the implementation monitoring and process evaluation for the SHAPES-D project.

2. Methods

2.1. Participants

In an effort to include all types of preschools, a combination of public, commercial, and religious preschools that had at least two classrooms with 3- to 5-year-old children within a moderately-sized southern city were identified and approached to gauge interest in participating in the intervention. The exact number of preschools available within this city cannot be identified; however, all schools and districts who were approached agreed to

Table 1
Demographic characteristics of participating schools.

Schools (n)	9
Classrooms (n)	26
3-year-old classes	12
4-year-old classes	13
4- and 5-year-old classes	1
Students (n)	515
Race/Ethnicity Students (%) ^a	
White/Caucasian	66.85
Black/African American	12.4
Hispanic/Latino	14.35
Asian	3.4
Mixed Race (two or more)	0.6
Teachers (n)	41
Years of teaching experience, mean (SD)	11.8 (9.8)
Years at the school, mean (SD)	4.5 (5.1)
Level of education, n (%)	
High school diploma	4 (11.1)
Some college	3 (8.3)
Associate's	4 (11.1)
Bachelor's	19 (52.8)
Master's	6 (16.7)
Teacher experience with online courses, n (%)	
First time taking an online course	6 (18.2)
Taken several online courses	15 (45.5)
Taken many online courses	12 (36.4)

^a Best estimates, data collected from multiple sources.

participate and helped to identify the classrooms and teachers who would take part in the program. A total of nine preschools (2 public, 3 commercial, 4 religious), with 41 lead and assistant teachers in 26 classrooms, joined the intervention. The SHAPES-D intervention had the potential to reach 515 preschool-aged children across the 26 classrooms. The majority of participating classrooms were 3- and 4-year-old classes (n=25), with one combined 4- and 5-year-old class. Participating lead teachers reported an average of 4.5 (SD = 5.1) years of employment at the participating school. Most teachers (81.9%) reported prior experience taking one or more online courses. A demographic breakdown of classrooms and teachers is presented in [Table 1](#).

2.2. Process evaluation procedures

Process evaluation procedures included monitoring the website to assess change agent (lead teacher) dose received, observing a subset of classrooms, and administering teacher surveys and interviews to assess completeness and fidelity of change agent (lead teacher) classroom implementation and barriers to implementation (lead and assistant teachers). Contents of the SHAPES-D program were hosted on an online server; the platform provided the interventionists with the ability to electronically track course interaction and completion. Each teacher was given a unique identifier upon registering for the SHAPES-D course, allowing for monitoring of individual participation and progress.

A subset of nine classrooms were observed for two full days by the same observer approximately one to two weeks apart; however, one classroom (Classroom O in [Table 2](#)) did not have the second observation due to scheduling conflicts. To select the classrooms to observe, the intervention team contacted the first teacher at a school who completed all six SHAPES-D modules; all teachers who were contacted agreed to be observed. Following the SHAPES-D program, all teachers completed a survey which assessed implementation of the SHAPES-D essential elements,

teachers' past experiences with online training, and their experiences with the SHAPES-D online delivery.

Finally, a sample of participating teachers completed in-depth teacher interviews to enable intervention staff to more thoroughly understand teacher experiences and perceptions of the SHAPES-D program. At least one teacher from each preschool site, and two teachers each from three sites, was randomly selected for the interview, yielding a total of twelve teachers.

2.3. Variable definitions

Three components of implementation were assessed: change agent (teacher) dose received, completeness of teacher classroom implementation (Move Inside, Move Outside, and Move to Learn), and fidelity of teacher classroom implementation (PA, social environment, and child enjoyment of PA).

2.3.1. Dose received

All SHAPES-D training was delivered online and relied upon teachers accessing the online materials and participating in online activities. Dose received was defined as the extent to which each teacher completed the six online modules, which included participating in discussion boards, with the desirable goal being completion of all six modules. Dose received was monitored electronically and is reported for lead teachers who participated in any training.

2.3.2. Completeness

PA among preschool students depends upon teachers providing PA opportunities via the SHAPES-D components (Move Inside, Move Outside, and Move to Learn). The goal presented in the SHAPES-D training was a total of 60 min of opportunities per day for full-day programs. The guideline specified 10 min each for Move Inside and Move to Learn, and 40 min for Move Outside (including 10-min of structured, teacher-led activities and 30 min of free play) per day; however, teachers were allowed flexibility and were encouraged to provide a total of 60 min based on resources and teacher preference. Completeness was defined as the percent of the 60-min daily goal reached in each classroom. Two data sources were used: process observation in a subset of classrooms (based on two in-person observations) and lead teacher report on the teacher survey at post-test. The survey asked teachers to report the amount of time each component was provided each day and how many times each week the components were offered. From this information, we were able to calculate the average time (in minutes) of PA opportunity per week. The survey, used in previous studies (Saunders paper under review), has not been previously validated with objective data. Higher implementation was defined as achieving at least 80% of the PA opportunity time goal.

2.3.3. Fidelity

Fidelity was assessed using three different concepts, including PA fidelity, social environment fidelity, and PA enjoyment fidelity. [Table 2](#) summarizes the sources and items used to determine fidelity.

PA fidelity was defined as most children engaging in MVPA during the PA opportunities that occurred during in-person observations in a subset of classrooms. Higher implementation was defined as an average of 0.75 or higher on the observation checklist index.

Social environment fidelity was defined as the teacher participating with children during PA opportunities (i.e., social modeling) in contrast to simply encouraging or supervising while children were active. There were two data sources: in-person observation in the subset of classrooms and lead teacher report on

Table 2
Items used to determine fidelity.

Type of Fidelity	Source	Items from source	Scoring and analysis
PA fidelity	Observation	For each component, including Move Inside and Move to Learn, the observer answered: <ul style="list-style-type: none"> • Most students were engaged in MVPA for 50% of the activity time. <ul style="list-style-type: none"> <input type="radio"/> Yes <input type="radio"/> No 	Yes = 1 No = 0 Scores were averaged together.
Social environmental fidelity	Observation	3 questions with the same responses: For each component, including Move Inside, Move Outside, and Move to Learn, the observer answered: <ul style="list-style-type: none"> • At least one teacher or adult staff actively participates in physical activity with children. <ul style="list-style-type: none"> <input type="radio"/> None of the time <input type="radio"/> Some of the time <input type="radio"/> Most of the Time <input type="radio"/> All of the Time 	None of the time = 1 Some of the time = 2 Most of the Time = 3 All of the Time = 4 Scores were averaged together.
	Survey	Q4. Which of the following best describes the adult leader during <i>Move Inside</i> activities in your classroom? Q10. Which of the following best describes the adult leader during <i>Move to Learn</i> activities in your classroom? Q17. Which of the following best describes the adult leader during <i>Move Outside</i> activities? Responses: <ul style="list-style-type: none"> • Adult provides supervision. • Adult sometimes encourages children to be active. • Adult frequently encourages children to be active. • Adult encourages and sometimes joins in activity. • Adult encourages and frequently joins in activity. 	Adult provides supervision. = 0 Adult sometimes encourages children to be active. = 1 Adult frequently encourages children to be active. = 2 Adult encourages and sometimes joins in activity. = 3 Adult encourages and frequently joins in activity. = 4 Scores for the 3 questions were averaged together
PA Enjoyment Fidelity	Observation	For each component, including Move Inside, Move Outside, and Move to Learn, the observer answered: <ul style="list-style-type: none"> • Most students appear to enjoy physical activity <ul style="list-style-type: none"> <input type="radio"/> None of the time <input type="radio"/> Some of the time <input type="radio"/> Most of the Time <input type="radio"/> All of the Time 	None of the time = 1 Some of the time = 2 Most of the Time = 3 All of the Time = 4 Scores were averaged together.
	Survey	2 questions with the same responses: Q5. In general, how did the children feel about <i>Move Inside</i> activities? (<i>check one</i>) Q11. In general, how did the children in your class feel about <i>Move to Learn</i> activities? Responses: <ul style="list-style-type: none"> • They hated it. • They did not like it. • They didn't dislike or like it. • They liked it. • They loved it. 	They hated it. = 0 They did not like it. = 1 They didn't dislike or like it. = 2 They liked it. = 3 They loved it. = 4 Scores for the 2 questions were averaged together

the teacher survey at post-test. Higher implementation was defined as an average of 3 or higher from the observation checklist and an average of 3 or higher on the teacher survey.

PA enjoyment fidelity was defined simply as students having fun during the PA opportunities. There were two data sources: in-person observation in a subset of classrooms (based on two observations) and lead teacher report on the teacher survey at post-test. Higher implementation was defined as an average of 3 or higher from relevant items from the observation checklist and an average of 3 or higher from 2 questions (Q5 and Q11) from the teacher survey.

2.4. Process evaluation measures

Process evaluation measures included website metrics, classroom observation checklist in a subset of classrooms, teacher surveys, and teacher interviews.

2.4.1. Website metrics

The intervention team was able to track each teacher's module participation and completion and discussion board postings via the online platform that hosted the SHAPES-D course. Teachers were asked to complete each module and post at least one response to the discussion board per module. To be considered complete, teachers were required to view the content of the module in its entirety as well as complete a brief quiz with a passing score of at least 80%. This online tracking allows for real-time implementation monitoring and can help with formative process evaluation (Arab et al., 2010; Saunders, 2015).

2.4.2. Classroom observation

A trained member of the SHAPES-D team conducted classroom observations after the observed teacher completed the SHAPES-D online program. The SHAPES-D team member indicated whether or not the SHAPES-D components (Move Inside, Move Outside, and Move to Learn) were provided, the equipment used during the

activities, the proportion of students actively participating, the percentage of time spent in MVPA, and teacher involvement. See [Appendix A](#) for the classroom observation checklist.

2.4.3. Teacher survey

Teachers independently completed the SHAPES-D teacher survey at post-test to assess completeness and fidelity of the SHAPES-D program. Assessment of completeness (PA opportunities through SHAPES-D components) and fidelity (social, PA, and enjoyment) was based on lead teacher report at the classroom level. Barriers were identified based on lead teacher and assistant teacher report. First, teachers reported the frequency and duration of SHAPES-D PA opportunities (Move Inside, Move Outside, and Move to Learn). Additionally, teachers were asked to indicate barriers to providing Move Inside, Move Outside, and Move to Learn activities (e.g., not enough time in the school day, comfort level with activities, lack of space, lack of equipment, lack of administrative support, etc.).

The survey also assessed the social context of PA opportunities. Teachers indicated whether or not they actively engaged with children when they provided Move Inside, Move Outside, and Move to Learn PA opportunities (e.g., provided supervision only, encouraged children to be active, joined in the activity). Additionally, lead teachers indicated whether the children disliked, liked, loved, or felt indifferent to Move Inside Move Outside, and Move to Learn activities in general.

Lead and assistant teachers reported their perceptions of many aspects of the SHAPES-D program, including the helpfulness of the modules, guidebook, discussion board, and sample activities. Finally, we examined lead teacher reports on the extent to which they felt prepared to carry out the SHAPES-D program and their intent to utilize SHAPES-D concepts or materials in the future. See [Appendix A](#) for the teacher survey.

2.4.4. Teacher interview

After completing the SHAPES-D program, twelve participating teachers completed a qualitative interview with a member of the research team in order to identify barriers to implementation and gauge teachers' reactions to the program. Teachers were asked about the program content, program delivery (e.g., feasibility of completing one module per week, feeling rushed to complete modules, optimal time of day to complete the modules, etc.), and challenges to completing the modules. The interview also addressed teachers' perceptions of other SHAPES-D materials (e.g., the SHAPES-D Guidebook, SHAPES-D sample activities, and online discussion board) and suggestions for improving the materials. Finally, teachers described perceived benefits and drawbacks of implementing SHAPES-D, and were prompted to provide any additional comments about their experiences with the SHAPES-D program.

2.5. Data analysis

Analysis considered multiple intervention components and data sources to examine patterns that revealed evidence of implementation. Data were summarized by lead teacher/classroom across the different variables and entered into a table to determine the level of implementation. If the criteria for implementation was met for each variable, the cell shading within the table was changed which allowed examination of implementation by each classroom and overall for all classrooms. Higher overall implementation at the classroom/teacher level was defined as meeting implementation criteria of 75% or higher across available data sources/components and summarized by frequencies and percentages presented in the table column. Four teachers did not provide responses to the survey, which precluded analysis

on completeness and fidelity; therefore, overall implementation was assessed via the percentage of classrooms meeting criteria for implementation using both 26 (all lead teachers for whom we have dose received data) and 22 classrooms (all lead teachers for whom we have completeness and fidelity data).

Barriers to implementation and the teacher overall response to SHAPES-D were determined by calculating the frequencies from the surveys. Additionally, qualitative data from the teacher interviews and surveys were investigated through open coding and inductive content analysis (Elo & Kyngäs, 2008) to determine the themes.

3. Results

SHAPES-D process data, based on lead teacher report, are summarized by classroom in [Table 3](#). Within the nine schools, 41 lead and assistant teachers in 26 classrooms completed the course. Each school had different methods for using lead, assistant, or co-teachers within the classroom. To assess classroom implementation, the lead teacher's data from the surveys was used with two exceptions. One school (Classrooms N and O in [Table 2](#)) used a co-teaching system, with four teachers in two classrooms; for this school we averaged the teachers' data to represent the classrooms in which they taught together. Also in [Table 3](#), Classroom V uses the assistant teacher's data, as the lead teacher left the school prior to completing the intervention; no other teachers who left the schools had assistant teachers.

3.1. Dose received

All 26 classrooms were considered in the dose received analysis. Nineteen of the 26 (73%) lead teachers who began the online training program completed all six modules, which included participation in the discussion board. Two teachers (8%) left their schools and were therefore dropped from the study, and an additional two teachers failed to respond to the teacher survey. We lacked data on these four teachers to assess completeness and fidelity; therefore, the assessments of completeness and fidelity are based on 22 classrooms.

3.2. Completeness and fidelity

Based on process observation, in nine of nine classrooms (100%) the teacher provided opportunities for the children to be active for at least 60 min per day. Based on lead teacher self-report, 21 of 22 classrooms (95%) met at least 80% of the weekly physical activity opportunity goal.

Of the nine classrooms selected to be observed two times, one classroom was only observed once due to scheduling conflicts; therefore, we were unable to calculate process fidelity scores for that classroom (Classroom O in [Table 3](#)). The eight classrooms observed twice had very high levels of observed PA opportunities (100%) and observed child enjoyment (100%). However, observed social environment fidelity (teacher being active with children) was low, as was PA fidelity (children engaging in MVPA during PA opportunities); both items were fulfilled in only 25% of observed classrooms. In contrast, teacher-reported social environment fidelity (being active with children) was very high (100%).

3.3. Overall implementation

Based on the 22 classrooms with complete data, 91% met the overall implementation criteria, (see [Table 3](#)). Based on the more conservative estimate using all 26 classrooms, 77% of the classrooms met the implementation criteria.

In summary, *dose received* was adequate at 73%. *Completeness* was very high, with observed PA opportunities at 100% and teacher reported PA at 95%. *PA enjoyment fidelity* was high, although *MVPA fidelity* and *social environment fidelity* appear to be low based on observation of a subset of classrooms. Overall implementation in the 22 classrooms with complete data, triangulating across multiple data sources, was high at 91%, and it was adequate at 77% when all 26 classrooms were included in the denominator.

The program was delivered to 26 lead teachers, creating a potential reach of 515 children. Although 76 children were in classrooms where SHAPES-D was not fully implemented (Classrooms A, B, C, G, S, T in Table 3), 439 children were reached in classrooms that met the overall implementation criteria.

3.4. Barriers to implementation

The teacher survey indicated that approximately 25% of the lead and assistant teachers found no barriers to implementing SHAPES-D. Move Inside had the fewest reported barriers (26.92% reporting no barriers), teachers reported no barriers to structured Move

Outside 25.45% of the time, and teachers reported no barriers to Move to Learn 23.21% of the time. Results indicated that the primary barrier for indoor activities was lack of space (reported 21.15% of the time). The primary barrier for outdoor activities was lack of equipment (12.73%). Lack of familiarity with the activities was commonly cited as a barrier across all three settings (Move Inside 11.54%, Structured Move Outside 9.09%, Move to Learn 10.71%). One notable barrier to implementation revealed in both the teacher survey and qualitative interviews was that some teachers felt that the activities were too advanced for the students.

During the teacher interview, one teacher did state that the program simply added “one more thing on my plate.” Teachers did, however, offer some suggestions for improvement, including launching implementation at the beginning of the school year and adding more activity examples.

3.5. Response to SHAPES-D

Overall, online delivery of SHAPES-D was very well-received by teachers, as evidenced by survey results and teacher interviews.

Table 3
SHAPES-D Process Results Summary: Implementation by Classroom.

Classroom	Process Evaluation Component								Total §
	Dose received	Completeness		Fidelity-PA	Fidelity-Social Environment				
	% modules & discussion boards completed	PA opportunity observed: % criteria	PA opportunity teacher: % weekly goal met	Observation	Social environment (teacher active with)	Child enjoyment			
	Online documentation	Process observation	Teacher reported	Process	Teacher	Process	Teacher	Process	
A*	5	-	-	-	-	-	-	-	-
B**	3	-	-	-	-	-	-	-	-
C	6	171	200	.67	3.67	2.9	2.5	3.9	5/8
D	6	-	83	-	4	-	4.0	-	4/4
E	4	-	263	-	4	-	3.5	-	3/4
F	6	163	175	.67	3	1.8	3.5	3.7	6/8
G**	3	-	-	-	-	-	-	-	-
H	6	108	92	.33	4	2.7	3.0	4.0	6/8
I	6	-	83	-	4	-	4.0	-	4/4
J	6	-	117	-	4	-	3.0	-	4/4
K	6	-	125	-	4	-	3.0	-	4/4
L	6	-	112	-	4	-	3.5	-	4/4
M	6	135	225	0	3.67	3.2	4.0	4.0	7/8
N***	6	-	297	-	4	-	3.5	-	4/4
O***	5.5	229	228	-	4	-	3.5	-	4/5
P	6	98	252	1.0	4	2.3	4.0	4.0	7/8
Q	6	208	80	.33	3.67	2.5	4.0	3.3	6/8
R	5	-	103	-	4	-	4.0	-	3/4
S*	6	-	-	-	-	-	-	-	-
T	5	-	75	-	3	-	2.0	-	1/4
U	6	-	167	-	4	-	3.0	-	4/4
V	6	-	305	-	3.67	-	3.5	-	4/4
W	6	-	297	-	4	-	4.0	-	4/4
X	6	136	297	.83	4	3.0	4.0	3.9	8/8
Y	6	-	200	-	4	-	4.0	-	4/4
Z	6	174	125	.5	4	2.9	4.0	3.9	6/8
Summary	19/26=73%	9/9=100%	21/22=95%	2/8=25%	22/22=100%	2/8=25%	20/22=91%	8/8=100%	20/22=91%
Criteria	6/6	≥ 80%	≥ 80%	≥ .75	≥ 3	≥ 3	≥ 3	≥ 3	>75% crit. met*

*must include at least one component of completeness **left the school

***No lead teacher. Two co-teachers scores averaged together

§ Number of components in which criteria are met/total number of data sources assessing implementation

Notes: areas highlighted meet the criteria; rows reflect teacher/classroom implementation and columns reflect process evaluation component implementation (i.e., dose received, completeness and fidelity)

The survey indicated that 62.5% of teachers plan to use SHAPES-D fully or with adaptations in the future. Another 37.5% of teachers plan to continue to use SHAPES-D ideas or materials. Furthermore, 100% of the teachers reported that the online modules were either very helpful (65.63%) or somewhat helpful (34.38%). However, 21% of the teachers did not think that the online discussion was helpful. Finally, the survey indicated that the lead teachers felt the program was worthwhile (mean 3.56, *s.d.* 0.79, with 4=very adequate and 0=very inadequate) and felt prepared to carry out SHAPES-D (mean 2.78, *s.d.* 1.38, median 3, with 4=very prepared and 0=very unprepared).

The qualitative interviews allowed for gathering more in-depth information from participating teachers. One teacher stated the following about the SHAPES-D program:

I thought it was great. We move but it's not always the top of the line physical activity that we should probably be doing all of the time, so it's definitely something to think about how to rework and put more of that in. What I have found through the years is that the kids respond well to moving. When they sit, they're good for about a minute or two and that's it, but when they're actually moving, they're learning and when we're singing and you do it, then it connects to the brain, I think it's amazing.

Some teachers thought that the online presentation of materials was especially helpful. For example, the videos embedded in the modules allowed teachers to watch demonstrations of activities conducted in preschool environments similar to those in which they worked. One teacher said:

When I saw the videos, the videos were really helpful because it showed me what they did around the classroom. It was helpful with the videos and the instruction. It gave more detail than just reading it in the book. Sometimes, I would just listen to it. It was more helpful than just reading the manual. I saw in the videos, that even though their classroom was small they could still do activities.

Other teachers read the included manual and thought that the online modules were simply a repeat of the manual. As one teacher noted, "Most of the time I would do the module after I read my book. I am old school. I like my pen and paper. I like my books. And so I felt the modules were more of a repeat or a review."

The qualitative interviews also suggested some teachers and schools may have had a higher level of readiness than others. Some teachers interviewed mentioned that they were incorporating PA before SHAPES-D and that SHAPES-D facilitated this further. Notably, one school incorporated SHAPES-D feedback into their performance appraisal for teachers.

Finally, the interviews allowed teachers to suggest potential improvements for the program, which included: providing more videos, providing more sample activities, providing a broader introduction to SHAPES-D, and beginning the program at the start of the school year.

4. Discussion

4.1. Summary of major findings

Overall, implementation was very high, with much higher levels of implementation than those currently reported in the literature (Bice, Brown, & Parry, 2014; Carroll et al., 2007; Durlak & DuPre, 2008). Carroll et al. indicate that success for interventions relies on high implementation fidelity (Carroll et al., 2007). Durlak and Dupree postulate that perfect implementation for any intervention is unrealistic and significant results can be seen at 60% implementation; few studies report higher than 80% implementation. (Durlak & DuPre, 2008). In a study by Bice and colleagues (2014), classroom teachers reported a 52.97%

implementation for CATCH, a school health program (Bice et al., 2014). Finch et al. indicate that lower levels of implementation by the teachers in their intervention may have impacted their non-significant improvements in child PA (Finch et al., 2014). SHAPES-D had higher or comparable overall implementation (based on classrooms with complete data or based on all classrooms including those that dropped out, respectively) than the original SHAPES study, which reported 75% overall implementation in Year 3 (Saunders et al., under review). Dissemination via online delivery appears to be viable, and we recommend using a web-based instructional method for delivery to change agents (i.e., teachers) in the future, as web-based teacher training provides opportunities for widespread reach (Barretto et al., 2011; Horvath, Ecklund, Hunt, Nelson, & Toomey, 2015; Lonsdale et al., 2016; Yoong et al., 2015). Furthermore, the ecological design of the program, intervening with the teachers rather than individual children, enabled the program to reach all the children in the classrooms in which SHAPES-D was implemented, allowing for greater reach within the setting (Green & Kreuter, 2005; Pate et al., 2005).

It is possible that the differences in implementation in the individual classrooms reflect, in part, differences in readiness and/or capacity of the teacher and/or the preschool. Lack of readiness and/or capacity of organizations has been indicated as a barrier to implementation (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004; Holt, Helfrich, Hall, & Weiner, 2010; Weiner, Lewis, & Linnan, 2009). For example, some teachers reported more barriers related to lack of space and equipment than others on the teacher survey. Additionally, the teachers did not vary greatly in experience with online courses; however, some did not feel as prepared to carry out SHAPES-D.

The teachers who participate in training are the change agents who implement SHAPES-D within their classrooms, and it is essential that the implementers are fully engaged and prepared. Therefore, it is important to assess the dose received to elucidate the change agents' level of engagement. Using online learning allows for easy monitoring of dose received via web metrics. Some studies have used web metrics to assist in the dose received assessment portions of process evaluation (Brady et al., 2015; Knowlden & Sharma, 2014); however, these interventions investigated programs that addressed individual behavior change. The SHAPES-D study may be the first structural intervention, aimed at changing classroom instructional practices and social environments, to monitor dose received using web metrics.

The flexible and online nature of the program allowed teachers to complete the modules at times that were convenient for them, which potentially facilitated an increased level of dose received. Additionally, creating multiple avenues for reviewing the material, online and through the manual, accounted for different learning styles, which may be an important aspect of online learning opportunities (Zacharis, 2011).

4.2. Limitations

This study does include limitations. Although this research supports the viability of a larger dissemination study, generalizability of the current study is limited since all preschools were located in the same city. Additionally, this study did not include a readiness assessment prior to implementation in any of the schools. Assessing readiness and capacity is an important step, and some teachers/schools may have had a higher state of readiness and capacity than others (Bond, Glover, Godfrey, Butler, & Patton, 2001; Holt et al., 2010; Lehman, Greener, & Simpson, 2002). This study also relied in part upon self-reported data, although observational data was used whenever possible. Finally, the sampling methods used to select classrooms to observe may have

led to observing stronger classrooms with a higher dose received, which could affect the results.

5. Lessons learned

First, we learned how to translate and adapt an in-person intervention for online delivery. Additionally, we learned that web-based delivery is a viable method to support the implementation of PA programs in childcare settings. This allows for broader dissemination and the opportunity for greater reach, thus decreasing the gap between research and practice.

Second, we learned about minor content changes to the program which could be beneficial to preschool teachers and the research team. For example, participating preschool teachers indicated that demonstration videos were very helpful in better understanding SHAPES-D concepts (e.g., PA intensity, and Move Inside, Move Outside, and Move to Learn activities); therefore, providing additional SHAPES-D videos in an easy-to-access online library would facilitate understanding and implementation. In addition to the videos, preschool teachers requested more resources, such as activities and recommended PA movements, which they could utilize during their lessons.

Third, in future SHAPES-D courses a readiness and capacity assessment will be delivered prior to and during implementation. This tool will assess the individual's readiness to implement new programs at the site, motivation for implementing the SHAPES-D program, and attitudes about implementing the SHAPES-D program.

Lastly, the SHAPES-D program began well into the second half of the academic year, at which point many teachers had already developed lesson plans for the remainder of the year. While SHAPES-D was designed to be integrated into existing lesson plans, some teachers may have been hesitant to adapt their plans so late in the school year. In order to promote increased implementation of SHAPES-D practices, it would be ideal to implement future waves of SHAPES-D at the beginning of the academic year.

Overall, results of the process evaluation indicated that minimal changes to the SHAPES-D program are necessary. However, in order to better understand the intervention, future additions to the process evaluation should include a readiness and capacity assessment. These lessons learned will help enhance the program as we move toward broader dissemination. Continued implementation monitoring and process evaluation allows for the team to easily adjust the program and helps to address issues as they occur rather than once the program is completed. The unique adaptation of a face-to-face intervention to an online delivery method will allow for greater dissemination of a successful program to increase PA in the preschool setting.

6. Conclusion

The comprehensive process evaluation conducted for the SHAPES-D program allowed for greater understanding of how SHAPES-D was utilized and received by participating preschool teachers. The process evaluation shed light on portions of the program that could benefit from revisions. One of the most important lessons learned was that, from an implementation point-of-view, the web-based program was well received and the use of technology to deliver the program online has the potential for great reach and public health impact compared to the original face-to-face delivery.

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Appendix A. Techer Survey and Observation Check list

SHAPES Teacher Survey

Teacher Name: _____ School Name: _____

Thank you for taking the time to complete this survey. You are being asked to participate because you are a preschool teacher in a participating school. The purpose of this questionnaire is to collect information regarding your feedback about the SHAPES Program. The information collected is strictly confidential and will be used only for the purposes of data analysis. Please note that this questionnaire is voluntary and you are free to skip any question that you would prefer not to answer. Your honest answers will help us improve how SHAPES is carried out. If you have any questions, feel free to contact Dale Murrie at 803-777-1023 or brabhamd@mailbox.sc.edu.

The following questions ask about Move Inside activities. Please think about these activities only when responding to these questions.

1. Which one of the following best describes how often *Move Inside* activities were carried out in your classroom in a typical week during this semester?

- A. 4–5 times
- B. 3 times
- C. 2 times
- D. 1 time
- E. 0 times

2. Which one of the following best describes how much time was spent each day, on average, in *Move Inside* activities in your classroom in a typical week during this semester?

- A. 26 min or more
- B. 21–25 min
- C. 16–20 min
- D. 11–15 min
- E. 1–10 min
- E. Not at all

3. How difficult was it to provide *Move Inside* activities adding up to 50 min each week?

- A. Very difficult
- B. Somewhat difficult
- C. Neither difficult nor easy
- D. Somewhat easy
- E. Very easy

4. Which of the following best describes the adult leader during *Move Inside* activities in your classroom?

- A. Adult provides supervision.
- B. Adult sometimes encourages children to be active.
- C. Adult frequently encourages children to be active.
- D. Adult encourages and sometimes joins in activity.
- E. Adult encourages and frequently joins in activity.

5. In general, how did the children feel about *Move Inside* activities? (check one)

- A. They hated it.
- B. They did not like it.
- C. They didn't dislike or like it.
- D. They liked it.
- E. They loved it.

6. What problems, if any, did you have in carrying out the *Move Inside* activities each week? (check all that apply)

- A. None

- B. Not enough time in the school day
- C. Comfort level with activities
- D. Limited (or lack of) space for activities
- E. Lack of familiarity with the activities
- F. Lack of equipment
- G. Lack of administrative support
- H. Administrative barriers in school (i.e. schedule changes/scheduling space)
- I. The children didn't like the *Move In* activities
- J. Other (please specify:)

The following questions ask about Move to Learn Lessons. Please think about these activities only when responding to these questions.

7. Which one of the following best describes how often *Move to Learn* activities were carried out in your classroom in a typical week during this semester?

- A. 8 or more times
- B. 6–7 times
- C. 4–5 times
- D. 2–3 times
- E. 0–1 times

8. Which one of the following best describes how much time was spent each day, on average, in *Move to Learn* activities in a typical week during this semester?

- A. 20 or more minutes
- B. 15–19 min
- C. 10–14 min
- D. 5–9 min
- E. 0–4 min

9. How difficult was it to provide *Move to Learn* activities, adding up to 50 min each week? (*check one*)

- A. Very difficult
- B. Somewhat difficult
- C. Neither difficult nor easy.
- D. Somewhat easy
- E. Very easy

10. Which of the following best describes the adult leader during *Move to Learn* activities in your classroom?

- A. Adult provides supervision.
- B. Adult sometimes encourages children to be active.
- C. Adult frequently encourages children to be active.
- D. Adult encourages and sometimes joins in activity.
- E. Adult encourages and frequently joins in activity.

11. In general, how did the children in your class feel about *Move to Learn* activities? (*check one*)

- A. They hated it.
- B. They did not like it.
- C. They didn't dislike or like it.
- D. They liked it.
- E. They loved it.

12. What problems, if any, did you have in carrying out the *Move to Learn* activities each week? (*check all that apply*)

- A. None
- B. Not enough time in the school day
- C. Comfort level with activities
- D. Limited (or lack of) space for activities
- E. Lack of familiarity with the activities
- F. Lack of equipment
- G. Lack of administrative support
- H. Administrative barriers in school (i.e. schedule changes/scheduling space)
- I. The children didn't like the *Move to Learn* activities
- J. Other please specify: _____

The following questions ask about Move Outside activities. Please think about these activities only when responding to these questions.

13. Which one of the following best describes how often *Move Outside* activities were provided for your classroom in a typical week during this semester?

- A. 10 or more times
- B. 7–9 times
- C. 4–6 times
- D. 1–3 times
- E. Not at all

14. Which one of the following best describes how much time was spent each day, on average, in *Move Outside* activities during this semester?

- A. 90 or more minutes
- B. 60–89 min
- C. 30–59 min
- D. 20–29 min
- E. 10–19 min
- F. 0–9 min

15. Which one of the following best describes how often weekly structured activities were provided for your class during recess in a typical week during this semester?

- A. 10 or more times
- B. 7–9 times
- C. 4–6 times
- D. 1–3 times
- E. Not at all

16. Which one of the following best describes how much time is spent in **structured activities** during *Move Outside* during this semester?

- A. 60 or more minutes
- B. 40–59 min
- C. 20–39 min
- D. 1–19 min
- E. Not at all

17. Which of the following best describes the adult leader during *Move Outside* activities?

- A. Adult provides supervision
- B. Adult sometimes encourages children to be active.
- C. Adult frequently encourages children to be active.
- D. Adult encourages and sometimes joins in activity
- E. Adult encourages and frequently joins in activity

18. What problems, if any, did you have in carrying out **structured** activities at recess? (*check all that apply*)

- A. None
- B. Not enough time
- C. Lack of familiarity with the activities
- D. Lack of Equipment
- E. Limited (or lack of) space for activities
- F. Administrative barriers (scheduling/space)
- G. Comfort level with activities
- H. The children didn't like to do the activities
- I. The children were active enough
- J. Lack of administrative support
- K. I didn't want to interrupt the children's play
- L. Other (please specify:)

The following questions are about the six online modules and the guidebook you used to learn about SHAPES and the support you felt from the online discussion groups.

19. How helpful were the online modules in helping you carry out SHAPES in your classroom?

- A. Very helpful
- B. Somewhat helpful
- C. Not at all helpful

20. How helpful were the online discussion groups in helping you carry out SHAPES in your classroom?

- A. Very Helpful
- B. Somewhat Helpful

- ___ C. Not at all Helpful
21. How helpful were the weekly goals in helping you carry out SHAPES in your classroom?
- ___ A. Very helpful
___ B. Somewhat helpful
___ C. Not at all helpful
22. How helpful was the guidebook in helping you carry out SHAPES in your classroom?
- ___ A. Very helpful
___ B. Somewhat helpful
___ C. Not at all helpful
23. How helpful were the sample activities in helping you carry out SHAPES in your classroom?
- ___ A. Very helpful
___ B. Somewhat helpful
___ C. Not at all helpful
24. How helpful was the feedback that you received from the intervention team?
- ___ A. Very helpful
___ B. Somewhat helpful
___ C. Not at all helpful
- SHAPES PROGRAM**
25. How would you rate the adequacy of the support you received from your school's administration to incorporate the SHAPES program?
- ___ A. Very adequate
___ B. Somewhat adequate
___ C. Neither adequate nor inadequate
___ D. Somewhat inadequate
___ E. Very inadequate
26. How would you rate the adequacy of the support you received from the SHAPES intervention team from USC to incorporate the SHAPES program?
- ___ A. Very adequate
___ B. Somewhat adequate
___ C. Neither adequate nor inadequate
___ D. Somewhat inadequate
___ E. Very inadequate
27. To what extent did you feel prepared to carry out the SHAPES program?
- ___ A. Very prepared
___ B. Somewhat prepared
___ C. Neither prepared nor unprepared
___ D. Somewhat unprepared
___ E. Very unprepared
28. How worthwhile was the SHAPES program for your classroom?
- ___ A. Very worthwhile
___ B. Somewhat worthwhile
___ C. Neutral
___ D. Not worthwhile
___ E. Not at all worthwhile
29. Which one of the following best describes your future plans with SHAPE?
- ___ A. I plan to continue using SHAPE fully.
___ B. I plan to use SHAPES with some changes.
___ C. I plan to use some ideas or materials from SHAPES.
___ D. I do not plan to use SHAPES in the future
30. What is your previous experience with on-line courses?
- ___ A. This was my first
___ B. I've taken several
___ C. I've taken many
31. How long have you been teaching at this school?
_____ years

32. Counting last year but not the current school year, how many years of experience do you have teaching? _____ years

33. What is your highest degree obtained?

34. Have you had any training/certifications beyond SHAPES for physical activity or health programs for preschoolers this year?
___ No ___ Yes

SHAPES-D Process Evaluation Observation Checklist

Date _____ Assessor ID _____

School _____ Teacher(s)/classroom observed _____

Day _____ **Session 1** **Session Start time:** _____ **Session End Time:** _____

Number of children _____ Number of adults _____

Location: indoors outdoors other _____

Weather: _____

Activity withheld as punishment ___ YES ___ NO

Activity used as punishment ___ YES ___ NO

Components observed

___ A. Move In Start time _____ Stop Time _____

Duration _____ minutes

___ B. Move to Learn Start time _____ Stop Time _____

Duration _____ minutes

___ C. Move Out

___ C1. unstructured play time Start time _____ Stop Time _____

Duration _____ minutes

___ C2. structured play time (e.g., game) Start time _____ Stop Time _____

Duration _____ minutes

Used Not Used Not Available

- Balls
- Tricycles
- Frisbees
- Hula Hoops
- Jump Ropes
- Fixed Equipment

Structured Games:

Obstacle course

___ D. PE Start time _____ Stop Time _____

Duration _____ minutes

To what extent were the following observed?

Component _____

Component	Yes					No				
	None of the Time	Some of the Time	Most of the Time	All of the Time	N/A	None of the Time	Some of the Time	Most of the Time	All of the Time	N/A
R1. Most students were engaged in MVPA for 50% of activity time										
R2. Most students had opportunities to be physical active	1	2	3	4	5					
R3. Most students appear to enjoy physical activity	1	2	3	4	5					
R4. Most students appear to engage in physical activity	1	2	3	4	5					
R5. At least one teacher or adult staff verbally encourages children to be physically active	1	2	3	4	5					
R6. At least one teacher or adult staff actively participates in physical activity with children	1	2	3	4	5					

R7. How many of the children participated in the activity?
 _____ Few _____ Some _____ Most _____ All

Component	Yes	No	N/A		
	None of the Time	Some of the Time	Most of the Time	All of the Time	N/A
R1. Most students were engaged in MVPA for 50% of activity time	1	2	3	4	5
R2. Most students had opportunities to be physical active	1	2	3	4	5
R3. Most students appear to enjoy physical activity	1	2	3	4	5
R4. Most students appear to engage in physical activity	1	2	3	4	5
R5. At least one teacher or adult staff verbally encourages children to be physically active	1	2	3	4	5
R6. At least one teacher or adult staff actively participates in physical activity with children	1	2	3	4	5

R7. How many of the children participated in the activity?
 _____ Few _____ Some _____ Most _____ All

Component	Yes	No	N/A		
	None of the Time	Some of the Time	Most of the Time	All of the Time	N/A
R1. Most students were engaged in MVPA for 50% of activity time	1	2	3	4	5
R2. Most students had opportunities to be physical active	1	2	3	4	5
R3. Most students appear to enjoy physical activity	1	2	3	4	5
R4. Most students appear to engage in physical activity	1	2	3	4	5
R5. At least one teacher or adult staff verbally encourages children to be physically active	1	2	3	4	5
R6. At least one teacher or adult staff actively participates in physical activity with children	1	2	3	4	5

R7. How many of the children participated in the activity?
 _____ Few _____ Some _____ Most _____ All

Comment/Notes:

Sedentary Behaviors

1. Did you observe children seated for more than 30 minutes at a time?

_____ YES 1a. How many times/day? _____ 1 _____ 2 _____ 3 _____ 4 _____ 5

_____ NO 1b. How many total minutes of seated activity (majority of the class seated) was observed?

_____ Minutes

2. Was a TV present in the room?

_____ YES _____ NO

3. Was TV viewing observed?

_____ YES 3a. Total minutes TV was on: _____ Minutes

3b. Was it on during meals? _____ YES _____ NO

3c. Was the TV used only for viewing education programs?

_____ YES _____ NO

4. Was a computer present in the room for use by children?

_____ YES _____ NO

5. Was computer game playing observed?

_____ YES 5a. Total number of minutes computer playing was observed:

_____ Minutes

5b. Was it being used for educational purposes only?

_____ YES _____ NO

5c. How many total children participated in computer playing during the entire day? _____ Number of children

_____ NO

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